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Status of ASKAP Control System

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ASKAP Software Engineer – Control Software Lead

11th October 2010 – EPICS Collaboration Meeting, BNL, NY



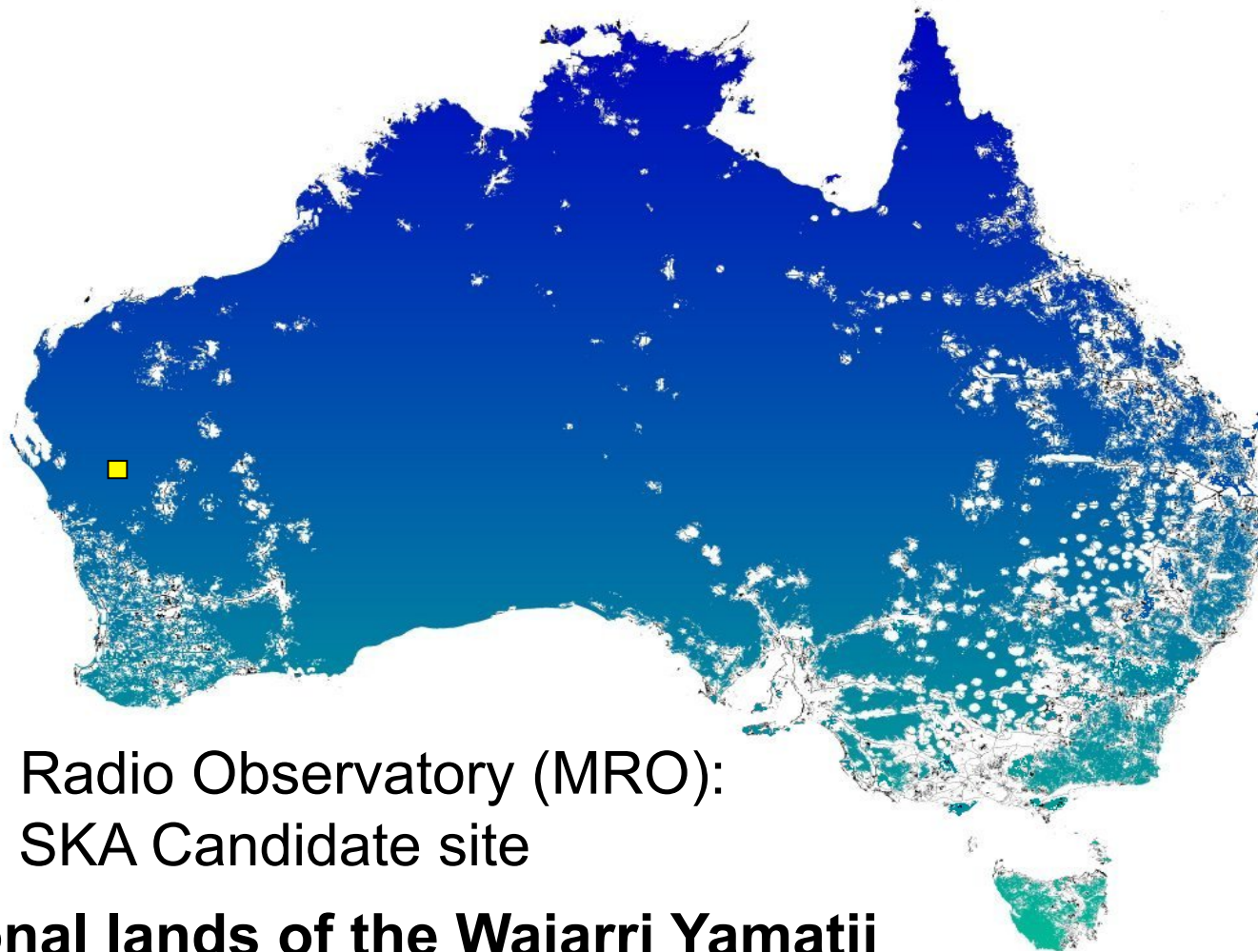
ASKAP Project

Australian SKA Pathfinder = 1% SKA

- Wide field of view radio telescope
 - Sited at Boolardy, Western Australia
 - Observes between 0.7 and 1.8 GHz
 - 36 antennas, 12m diameter, 3-axis
 - Phased Array Feed (PAF) technology (36 beams)
 - 30 sq degree field of view
 - 6 antenna prototype mid 2011- Boolardy Engineering Test Array (BETA)
 - Full system mid 2013
- Scientific instrument, optimised for survey
 - Survey HI emission from 1.7 million galaxies up $z \sim 0.3$
 - Deep continuum survey of entire sky
 - Polarimetry over entire sky
- Technical pathfinder
 - Demonstration of WA as SKA site
 - Phased Array Feeds
 - Computing



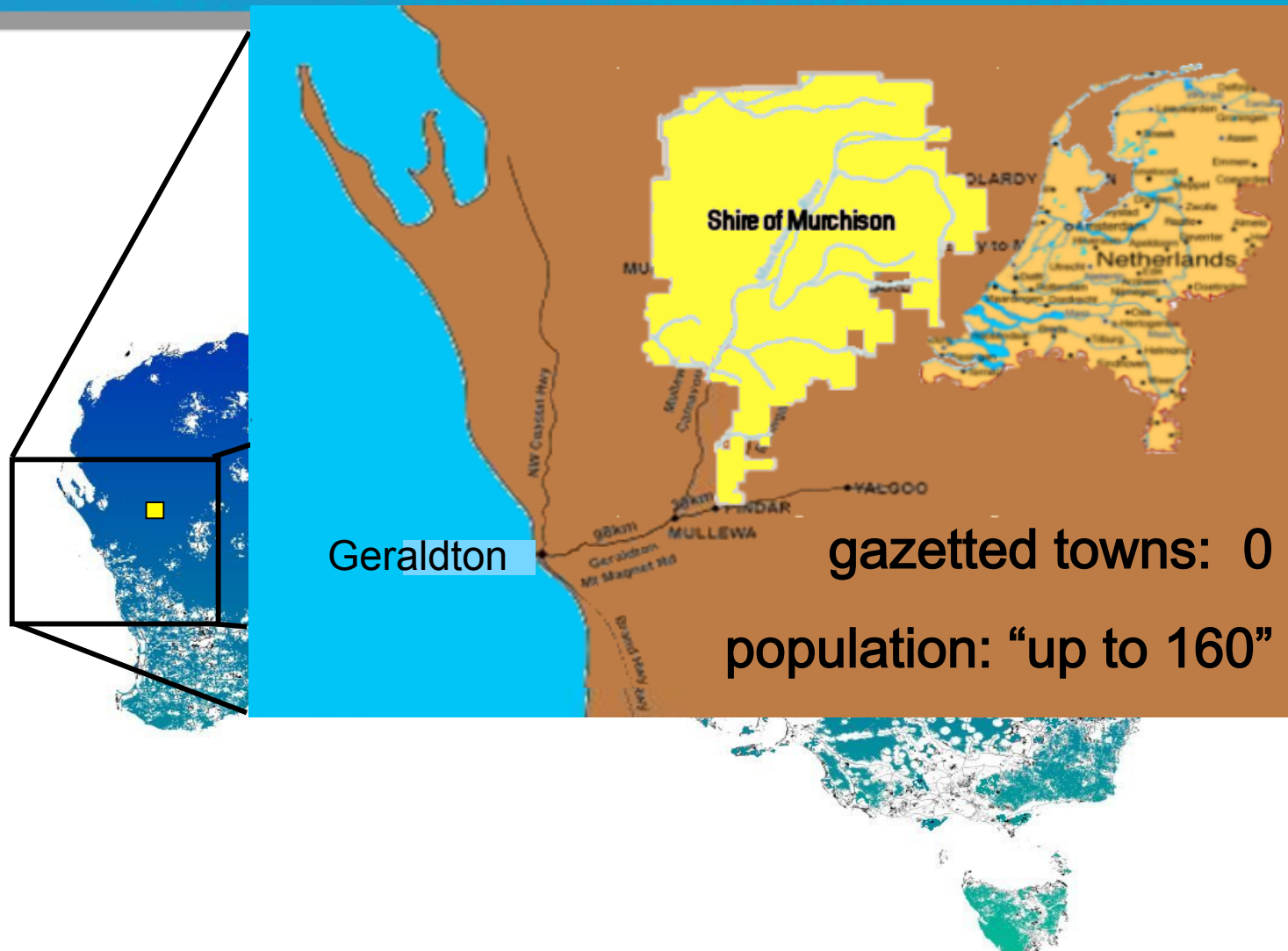
ASKAP Site



Murchison Radio Observatory (MRO):
Australia's SKA Candidate site

Traditional lands of the Wajarri Yamatji

ASKAP Site



ASKAP Project Timeline

Jan 2010	First antenna installed at the site
May 2010	Subsystem's CDR completed
Mar 2011	Installation of Full-PAF + new hw/sw backend at Parkes
Mar 2011	SAT of antenna 2 – 6 (BETA) completed
May 2011	Fibre-link between Geraldton and MRO complete
Jun 2011	Installation of Full-PAF+hw/sw back-end on BETA begins
Aug 2011	Early commissioning of BETA begins
Oct 2011	MRO infrastructure complete
Jan 2012	Installation/SAT of antennas 7 – 36 complete
Nov 2012	36 ASKAP antennas with PAF + hw/sw installed
Dec 2012	ASKAP “Early Science” (commissioning/shared risk)
Jul 2013	Initial Science Survey Projects observing

ASKAP Site



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ASKAP Site



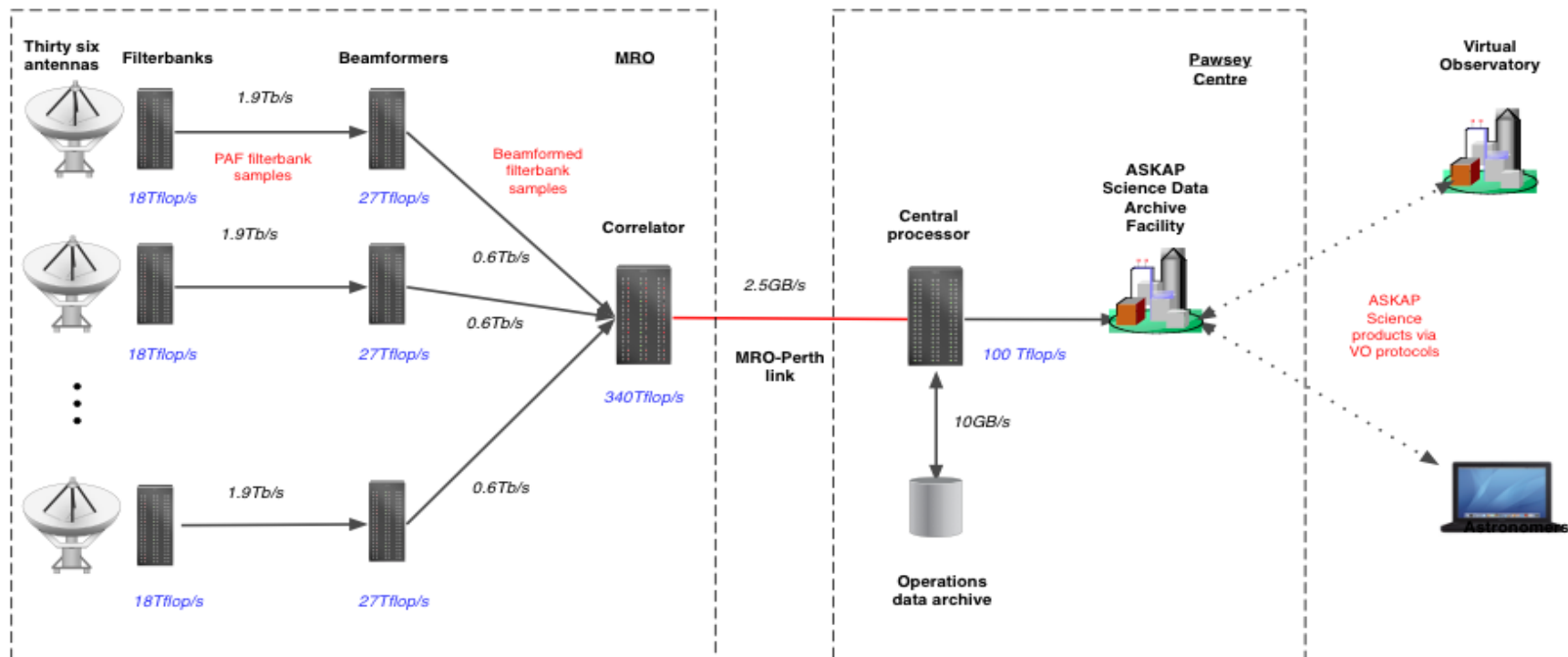
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ASKAP Site



ASKAP Data Flow

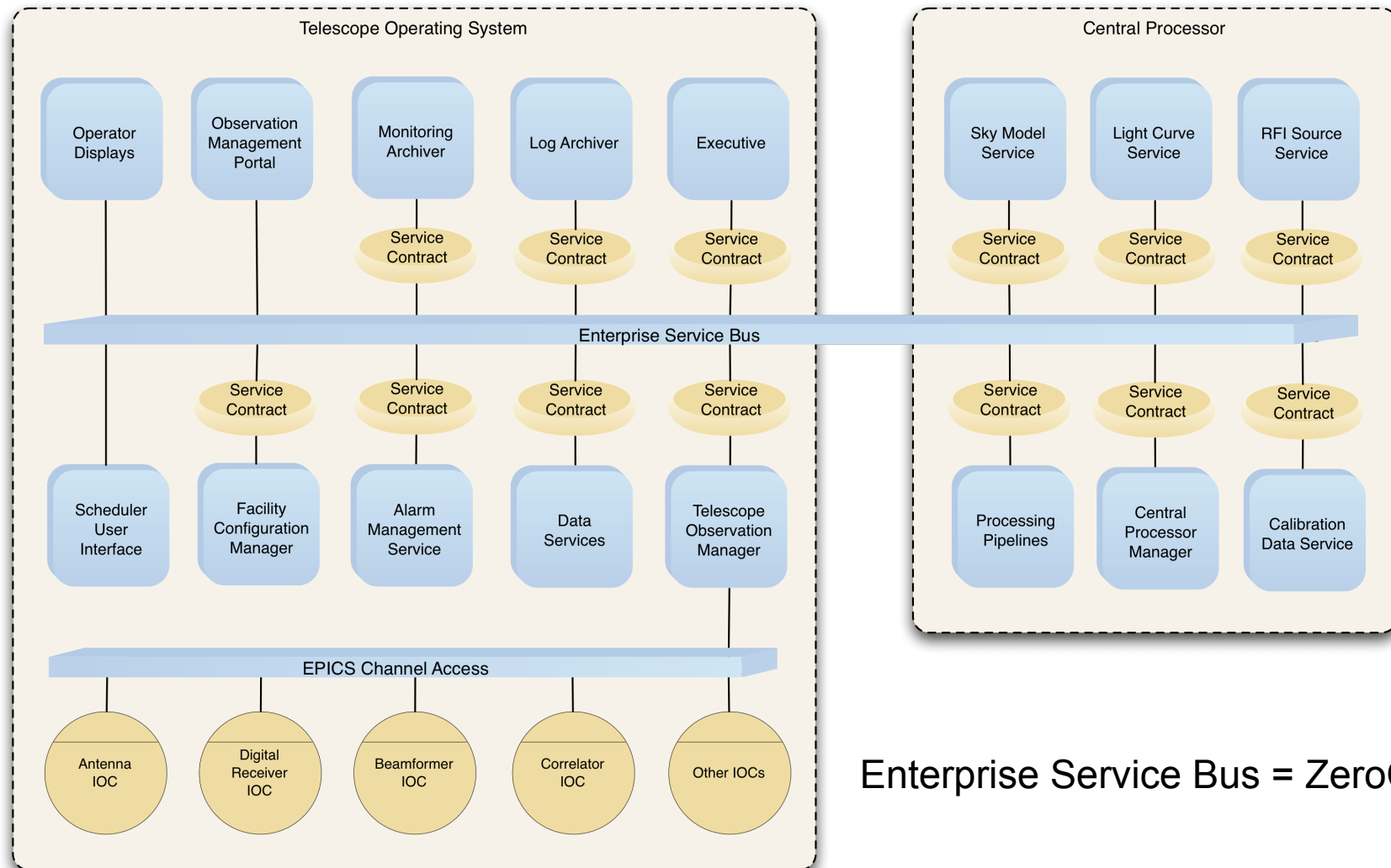
ASKAP FPGA-based signal processing chain



T. Cornwell, Feb 22 2010



ASKAP Control Software Architecture



Enterprise Service Bus = ZeroC ICE

EPICS IOC Implementation

- Using EPICS base 3.14.11
 - Support (development) for Linux (x86_64) and MacOSX (Snow Leopard)
 - No need for real-time OS extensions for now
- Estimated number of records ~ 180,000 (~ 5,000/antenna)
- Estimated number of deployed IOCs ~ 40
 - SoftIOC on Linux (non-real time) OS
 - We call them Control Computers
 - 1U rack-type computers running standard Linux (debian) distro x86_64 type (diskless or solid-state disk)

EPICS IOC Implementation

- Design and write the EPICS database (list of EPICS records). Use of ICD as reference
 - Keep IOC database as simple as possible
 - Extensive use of MSI
- Write SNL programs for some applications (version 2.0.12)
- Extensive use of EPICS ASYN framework (version 4.14)
 - Code needs to be added if field-bus protocol requires additional ASYN interfaces, i.e. driver support for the ASKAP Digitiser (UDP-based protocol)
 - Driver support can be re-used. We are planning to use same ASKAP digitiser driver support for LO, Beamformer and Correlator
- Implement an emulator (Python)
 - Essential for continuous integration and testing of high-level software components
 - Most of our hardware devices are Ethernet-enabled
- Implementation of EPICS IOC applications are done mainly by Computing Team (Control Group), but in some cases are shared development, i.e. Analog Subsystem

EPICS Implementation Status

Subsystem	Implementation Status	Fieldbus/Protocol
Antenna Drives	50 %	Ethernet/TCP (ASKAP) and Modbus/TCP (Parkes 12m)
Pedestal and Prime Focus Analog Electronics	50 %	Ethernet/UDP(SPI)
LO	50 %	Ethernet/UDP
Timing	Completed	Ethernet/UDP/PCI
Digitiser	Completed	Ethernet/UDP
Beamformer	0% ICD in progress	Ethernet/UDP
Correlator	0 %	Ethernet/UDP
Power and Cooling	0 %	Ethernet/TCP(Modbus)/SNMP
MRO Weather Station	0 %	Ethernet/TCP
MRO Safety (Fire alarms, interlocks)	0 %	Ethernet/ModbusTCP
MRO Networking Hardware	0 %	Ethernet/SNMP

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EPICS Clients Implementation

- Using our own Archiver
 - ASKAP will use software called MoniCA which is used for the Monitoring Archiver role at all other CASS/ATNF Observatories
 - Implemented in Java
 - Supports MySQL and ASCII database backends
 - EPICS CA support via JCA library
 - Google “open-monica” or <http://code.google.com/p/open-monica/>
- GUIs
 - Started using EDM but there are some issues on x86_64 and MacOSX
 - Converting screens to Qt 4.6 + epicsqt library (Australian Synchrotron)
- Test scripts
 - Implemented in Python
 - EPICS CA support via cothread 1.15 (Diamond)
- VirtualTOS (vtos)
 - Stand-alone package with SoftIOC emulating antenna IOCs + High level applications for creating/executing observations

Build Infrastructure Features

- Revision control system: Subversion
- Support for C/C++, Java and Python for our code
- Platform independent
 - Compiles in Linux (Debian) and MacOSX
 - Deploy only Linux
- Automated building (and deployment) of dependencies
 - A single build command (rbuild)
 - Updates from subversion repository
 - Recursively builds a package's dependencies
 - Written in Python
 - The dependencies.default file lists a packages dependencies
 - To avoid dependency loops have a simple dependency structure
 - Wraps several “make” tools: autotools, epics makefiles, scons, ant and setuptools
 - Integrate lots of 3rd party software as part of our build
 - Standard patching procedure and option settings
 - Support parallel builds – to speed up a little bit
 - Wraps documentation generation tools: doxygen and Sphinx
 - Can build and run unit and functional test

Project Management Tool

Redmine

- Switched from Trac to Redmine late 2009
 - Redmine: <http://www.redmine.org>
 - Open source project management web application written in Ruby on Rails
 - Allows sub-projects, so it is used by ASKAP
 - Use the concept of issues (task, bug, feature, etc.) and milestones
 - Wiki
 - Linked to source repository (SVN, CVS, Git, Mercurial, etc.)
 - Email notifications
 - Time tracking (although we don't use this)

Project Management Tool

Redmine

The screenshot shows a web browser window displaying the Redmine project management tool. The browser's address bar shows the URL <https://pm.atnf.csiro.au/askap/projects/show/cmpt>. The page has a dark blue header with navigation links: Home, My page, Projects, and Help. A search bar and a "Jump to a project..." dropdown are also present. The main content area is titled "Computing" and includes a sub-header "Overview". The "Overview" section provides details about the "ASKAP Computing IPT" project, listing the Project Lead (Tim Cornwell), Project Engineer (Ben Humphreys), Project Manager (Alan Ng), and Project Scientist (Simon Johnston). It also mentions that the project is a subproject of "ASKAP the Telescope". To the right of the overview, there is a "Members" section listing the Manager (Tim Cornwell), Leader (Ben Humphreys, Juan Carlos Guzman, Matthew Whiting), Developer (Alan Ng, David Brodrick, Euan Troup, Ger van Diepen, Malte Marquarding, Maxim Voronkov, Neeraj Gupta, Simon Hoyle, Simon Johnston, Tony Maher), and Reporter (Aaron Chippendale, Aaron Sanders, Andrew Brown, Angela Hein, Antony Schinckel, Brett Preisig, Brian Boyle, Carole Jackson, Charles Smith, Chris Cantrall, Chris Phillips, Craig Russell, Dave Smith, David DeBoer, Douglas Hayman, Emil Lenc, Evan Davis, Evert Rol, Gabby Russell, Gabriella Frost, George Hobbs, Gordon Xue, Graham Allen, Grant Hampson, Jeffrey Vera, John Bunton, John Reynolds, John Tuthill, Jonathan Khoo, Joseph Pathikulangara, Keith Bannister, Kjetil Wormnes, Kylie Fraser, Li Li, Ludi De Souza, Mark Leach, Michael Brothers, Michael Kesteven, Michelle Storey, Nathan Pope, Neale Morison, Paul Roberts, Priscilla Clayton, Ron Beresford, Ross Forsyth, Russell Gough, Shaun Amy, Simon Mackay, Steve Barker, Suzy Jackson, Tim Bateman, Tony Mulry, Troy Elton, Urvashi Rau, Vicki Fraser, Vincent McIntyre, Wan Cheng). On the right side of the page, there is a sidebar with sections for "Planning" (Calendar | Gantt), "Spent time" (194.35 hours), and "Details | Report". At the bottom left of the sidebar, there is a link to "View all issues".

Computing - Overview - AS: X

<https://pm.atnf.csiro.au/askap/projects/show/cmpt>

Home My page Projects Help

Logged in as **guz006** My account Sign out

Computing

Search: Jump to a project...

Overview Activity Roadmap Issues New issue Documents Wiki Files Repository Settings

Overview

ASKAP Computing IPT.

Project Lead: Tim Cornwell
Project Engineer: Ben Humphreys
Project Manager: Alan Ng
Project Scientist: Simon Johnston

- Subproject of: [ASKAP the Telescope](#)

Issue tracking

- Bug: 18 open on 149
- Feature: 59 open on 742
- Support: 1 open on 6
- Task: 47 open on 122

[View all issues](#)

Members

Manager: Tim Cornwell

Leader: Ben Humphreys, Juan Carlos Guzman, Matthew Whiting

Developer: Alan Ng, David Brodrick, Euan Troup, Ger van Diepen, Malte Marquarding, Maxim Voronkov, Neeraj Gupta, Simon Hoyle, Simon Johnston, Tony Maher

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Planning

[Calendar](#) | [Gantt](#)

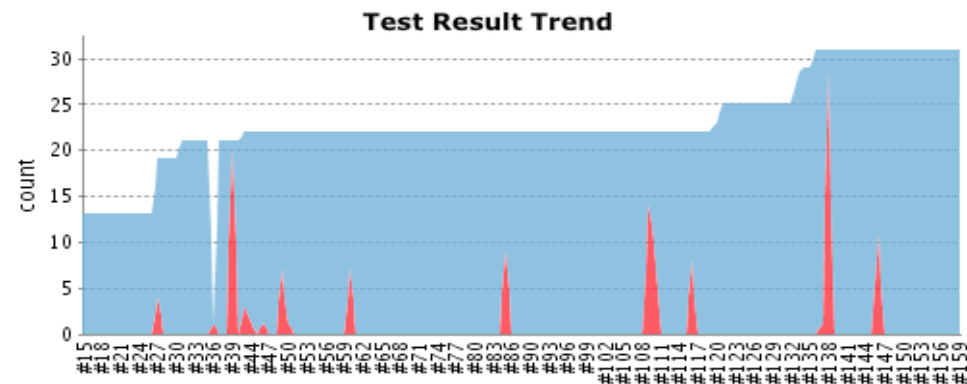
Spent time

194.35 hours

[Details](#) | [Report](#)

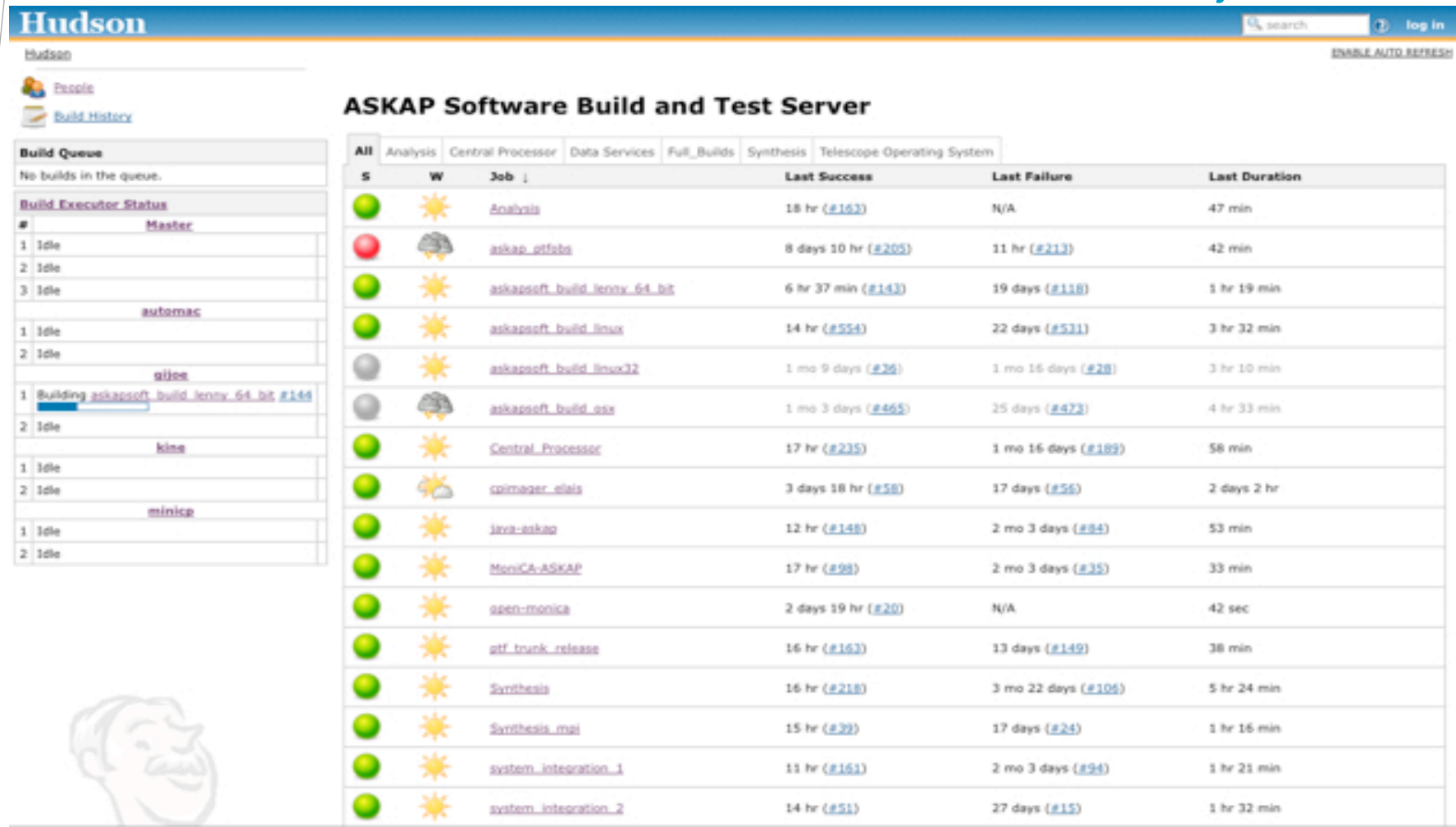
Continuous integration

- Adopted continuous integration process in July 2009
 - Using Hudson open-source tool: <https://hudson.dev.java.net/>
 - ASKAPsoft codebase is tested continuously and automatically
 - Each commit to the Subversion repository results in a build/test job being spawned
 - Immediate productivity improvements obvious
 - Reduced time to detect defects (particularly regressions) from days/weeks to hours
 - Easily able to identify exactly which change-set caused the problem
- Trend test additions, deletions, passes and fails over time



Continuous integration

- Hudson dashboard shows status of all build executors and jobs



Hudson search log in ENABLE AUTO REFRESH

[People](#) [Build History](#)

Build Queue
No builds in the queue.

Build Executor Status

#	Master
1	Idle
2	Idle
3	Idle

automac

1	Idle
2	Idle

gijoe

1	Building askasoft_build_lenny_64_bit #144
2	Idle

king

1	Idle
2	Idle

minicp

1	Idle
2	Idle

ASKAP Software Build and Test Server

All	Analysis	Central Processor	Data Services	Full_Builds	Synthesis	Telescope Operating System
S	W	Job	Last Success	Last Failure	Last Duration	
●	☀	Analysis	18 hr (#163)	N/A	47 min	
●	☁	askap_gtfobs	8 days 10 hr (#205)	11 hr (#213)	42 min	
●	☀	askasoft_build_lenny_64_bit	6 hr 37 min (#143)	19 days (#118)	1 hr 19 min	
●	☀	askasoft_build_linux	14 hr (#554)	22 days (#531)	3 hr 32 min	
●	☀	askasoft_build_linux32	1 mo 9 days (#36)	1 mo 16 days (#28)	3 hr 10 min	
●	☁	askasoft_build_oss	1 mo 3 days (#465)	25 days (#472)	4 hr 33 min	
●	☀	Central_Processor	17 hr (#235)	1 mo 16 days (#189)	58 min	
●	☁	cpimager_elais	3 days 18 hr (#58)	17 days (#56)	2 days 2 hr	
●	☀	java-askap	12 hr (#148)	2 mo 3 days (#84)	53 min	
●	☀	MoniCA-ASKAP	17 hr (#98)	2 mo 3 days (#35)	33 min	
●	☀	open-monica	2 days 19 hr (#20)	N/A	42 sec	
●	☀	gtf_trunk_release	16 hr (#163)	13 days (#149)	38 min	
●	☀	Synthesis	16 hr (#218)	3 mo 22 days (#106)	5 hr 24 min	
●	☀	Synthesis_mai	15 hr (#39)	17 days (#24)	1 hr 16 min	
●	☀	system_integration_1	11 hr (#161)	2 mo 3 days (#94)	1 hr 21 min	
●	☀	system_integration_2	14 hr (#51)	27 days (#15)	1 hr 32 min	

Square Kilometer Array (SKA)

- Download the SKA animation movie from http://www.skatelescope.org/video/SKA_Animation_2010.mov
 - Credit: Swinburne University

Square Kilometer Array

Top-level Timeline

2007 – 12	Telescope design and cost
2012	Site selection (Australia or Southern Africa)
2012 – 13	Establish SKA organisation + initial (10% SKA Phase 1) construction funding approval
2013 - 18	Detailed design & construction of Phase 1 at low and mid frequencies
End 2016	Construction funding approved for 100% SKA at mid and low frequencies
2017 - 22	Finish construction at low and mid frequencies
2019 ->	Science operations with Phase 1
2023	Full operations at low and mid frequencies
2013 - 22	High frequency technology development
2023 ->	Start construction of SKA at high

**Australia Telescope National Facility
CSIRO Astronomy and Space Science**

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Web: <http://www.atnf.csiro.au/projects/askap/>

www.csiro.au

Thank you

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